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Marathon Oil Company Rocky Mountain Oil Operations

Cody, Wyoming

Toxicity Reduction Evaluation Plan for Outfall 001 from the Steamboat Butte Field

NPDES Permit No. WY-0033740

ENSR | AECOM

August 2008

Document Number 08503-131-074

Rocky Mountain Oil Operations
Northern U.S. Business Unit

Marathon Oil Company

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August 14, 2008

U.S. Environmental Protection Agency
1595 Wynkoop Street
Denver, Colorado 80202

FedEx – Priority Overnight

Attn: Colleen Gillespie
(303) 312-6133

Re: Toxicity Reduction Evaluation Plan
Marathon Oil Company
Steamboat Butte Field WY-0033740
Wind River Indian Reservation

Dear Ms. Gillespie,

Enclosed for your review and approval, please find the *Toxicity Reduction Evaluation Plan* for the produced water effluent from the Steamboat Butte Field. This document has been prepared by the ENSR Environmental Toxicology Laboratory in conjunction with Marathon Oil Company. The purpose of this plan is to summarize potential strategies, methodologies, resources, and deliverables to reduce the sulfide toxicity exhibited at Outfall 001, which discharges to Upper Mission Pond. An anticipated project schedule is also included for your review. Marathon is looking forward to frequent communication with your office as we progress through this process in a stepwise manner.

Please feel free to contact me at (307) 527-2127 with any questions or comments.

Respectfully Submitted,
Marathon Oil Company

M. W

Michael A. Williams, P.G.
HES Professional
NAPO Rocky Mountain Operations

CEIVED
AUG 15 2008

cc: Wind River Environmental Quality Council
MOC Wind River Field Office
Cody HES Files (Steamboat Butte)

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Toxicity Reduction Evaluation Plan for Outfall 001 from the Steamboat Butte Field

(NPDES Permit No. WY-0033740)

Prepared by

Marathon Oil Company
Rocky Mountain Oil Operations
Cody, Wyoming

and

ENSR | AECOM
ENSR Environmental Toxicology and Water Resources
Fort Collins, Colorado

August 2008

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1.0 INTRODUCTION

This Toxicity Reduction Evaluation (TRE) Plan will first summarize the site conditions, permit requirements, and toxicity testing results for a produced water outfall at the Marathon Oil Company (Marathon) Steamboat Butte oil field. A discussion of the proposed approach, objectives, and technical methods of the TRE is included. Some possible approaches are outlined which include compliance strategies, process modifications, and treatment alternatives. Periodic deliverables, team organization, individual responsibilities, and an anticipated project schedule are also provided in this TRE Plan.

1.1 History of Facility and Water Discharge

Marathon Oil Company (Marathon) purchased the Steamboat Butte field from Chevron and commenced operations in 1997. Since the 1940's produced water derived from the Steamboat Butte oil field had been discharged to the Mission Lake drainage system by other operators. The accumulation of produced water within Mission Ponds has resulted in a perennial water supply that is of benefit to wildlife and livestock.

With increased energy development, the volume of produced water has increased over time. In recent years, Marathon enhanced the Mission Lake system with the addition of rip-rap around the perimeter of the pond and the construction of three wetlands along the drainage. Currently, Marathon discharges approximately 30,000 barrels of produced water per day (1,260,000 gallons/day) through the permitted National Pollutant Discharge Elimination System (NPDES) outfall 001 that feeds the Mission Lake system. As illustrated by Figure 1-1, three bodies of open water currently exist as Upper Mission Pond, Lower Mission Pond, and the western constructed wetland. The water levels and discharge from the western wetland is currently managed by United States Fish and Wildlife personnel. Two additional constructed wetlands occur further downstream; however, these facilities are normally dry except when water is released from the upstream wetland.

In accordance with the Wyoming Department of Environmental Quality groundwater quality standards, the quality of the produced water (TDS <4000 mg/l) is suitable for wildlife, and livestock consumption. Considerable habitat has developed around the Mission Pond system, as lacustrine, riparian, and wetland flora and fauna are abundant in this otherwise arid and sparsely vegetated area. Marathon has numerous testimonials which document the additional benefits to wildlife, habitat, and downstream livestock resulting from the perennial supply of water discharged to the Mission Ponds and associated wetland system.

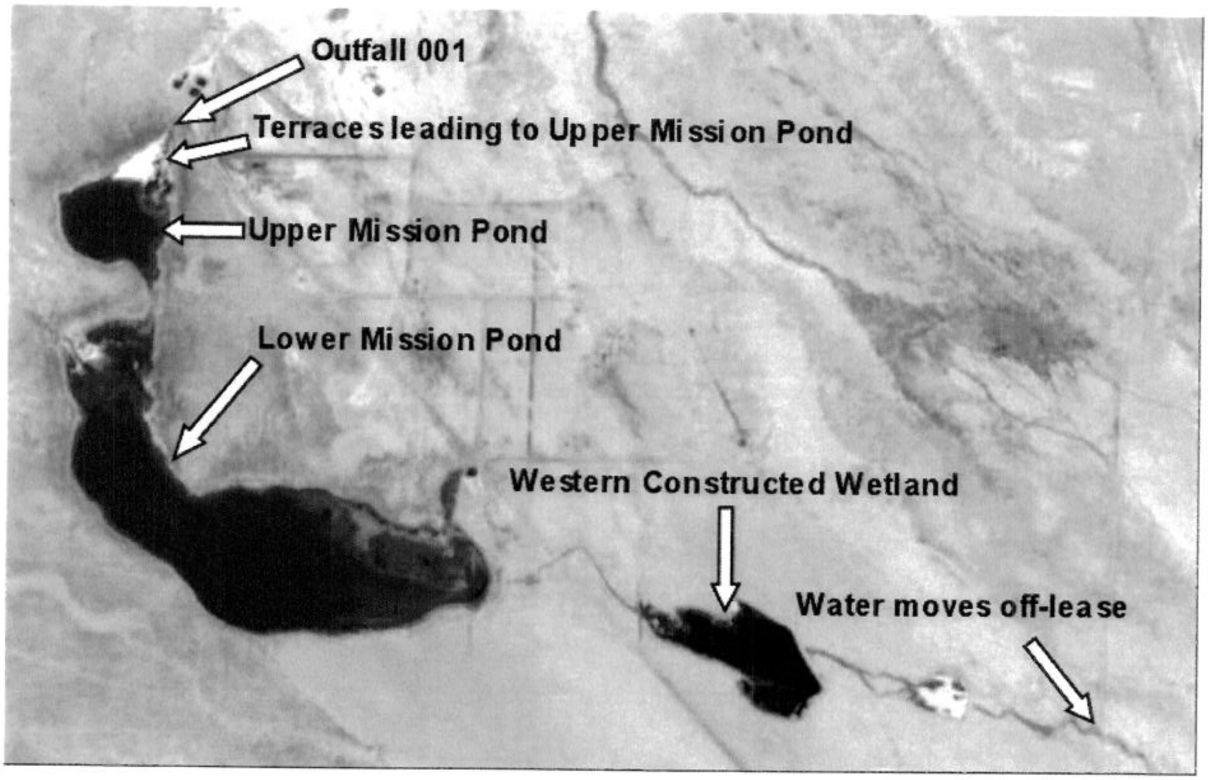

Figure 1-1. Outfall 001 from Steamboat Butte field, Mission Ponds, and downstream wetlands.

1.2 Whole Effluent Toxicity Testing History

Final effluent discharged from the Marathon's Steamboat Butte field is regulated by the United States Environmental Protection Agency (USEPA), NPDES Permit Number WY-0033740. As listed within this permit, whole effluent toxicity (WET) tests are required to be conducted every six months on a grab sample of the final effluent from Outfall 001. Specifically, the final permit requirements (effective on October 1, 2007) for WET testing are shown in Table 1-1.

TABLE 1-1
Whole Effluent Toxicity Testing Requirements for NPDES Permit WY-0033740

Required Testing	Dilutions	Frequency	Pass/Fail Criteria
48-hour *Ceriodaphnia dubia* Acute Static-Renewal Test	100% and a control (0% effluent)	Every 6 months beginning within 60 days of effective date of permit	No significant (α=0.05) lethality in 100% Effluent (NOAEC = 100%)[a]
48-hour *Pimephales promelas* (Fathead Minnow) Acute Static-Renewal Test			

[a] NOAEC = No Observed Adverse Effect Concentration

As described within the discharge permit:

> *Acute Toxicity is observed when the lethality in 100% effluent is statistically different from the control (0% effluent) at the 95% confidence level.*

During acute WET tests conducted Oct. 30 to Nov. 1, 2007 by Energy Laboratories in Billings, MT, the effluent from outfall 001 exhibited significant toxicity to both *Ceriodaphnia dubia* and *Pimephales promelas* (fathead minnow) with No Observed Acute Effect Concentrations (NOAECs) <100% effluent at test termination (48 hours). Actual survival of both species was 0% (100% mortality) at 24 hours.

In addition to the WET tests conducted on the effluent sample collected from outfall 001, toxicity tests were also conducted using water collected downstream of outfall 001 and the Mission Ponds. Acute tests were initiated in October 2007 with water sampled from just upstream of the confluence with the Wind River. Those tests showed no toxicity (100% survival) at 48 hours to either *C. dubia* or the fathead minnow.

Acute tests were also initiated in November 2007 with water collected at the outfalls of Upper Mission Pond and Lower Mission Pond. There was no significant mortality to *C. dubia* or fathead minnows in 100% Upper Mission Pond water. Survival of fathead minnows in 100% Lower Mission Pond water was not significantly reduced relative to the control, although *C. dubia* survival was significantly reduced. Actual survival of *C. dubia* was much higher than in 100% effluent from outfall 001. Survival at 24 and 48 hours in effluent, Mission Pond and Wind River confluence studies are shown in Table 1-2.

Table 1-2. Survival of *C. dubia* and Fathead Minnows in 48-Hour Acute Toxicity Tests with Outfall 001 Effluent and Three Waters

Time (hours)	Percent Survival in 100% Test Water							
	Ceriodaphnia dubia				*Pimephales promelas*			
	001 Effl	Wind R. Confl.	Upper Mission Pond	Lower Mission Pond	001 Effl	Wind R. Confl.	Upper Mission Pond	Lower Mission Pond
0 (start)	100	100	100	100	100	100	100	100
24	0	100	100	100	0	100	100	100
48	0	100	97.5	72.5	0	100	92	98

1.3 Toxicity Reduction Evaluation

1.3.1 TRE Overview

A TRE is defined as "a site specific study conducted in a stepwise process designed to identify the causative agents of effluent toxicity, isolate the sources of toxicity, evaluate the effectiveness of toxicity control options, and then confirm the reduction in effluent toxicity" (USEPA, 1991a). Basically, the purpose of a TRE is to:

1. Determine what is causing the toxicity and/or where the toxicity is coming from,
2. Determine what actions must be taken or procedures applied to reduce toxicity to an acceptable level,
3. Implement those actions or procedures, and
4. Confirm that the toxicity has been sufficiently reduced.

The components of a TRE are not fixed and the entire process is specifically designed as being fluid and flexible, whereby those conducting the TRE can change directions, add components and modify methods depending upon the data gathered as the TRE progresses. For example, if spatial toxicity investigations find that WET is apparent in the final effluent at the collection point but is absent when samples are collected upstream of a specific treatment process, then the focus of the TRE may shift to that treatment process and the chemical, physical, and biological changes that are occurring.

In some situations it may not be necessary to specifically identify the cause of toxicity if a reasonable solution presents itself. For example, if increased aeration is effective in eliminating toxicity of a wastewater, and that can be implemented quickly and cost-effectively, then identification of the specific toxicant(s) may not be required.

1.3.2 TRE Objectives and Approach

A TRE may be defined in terms of four general objectives (USEPA 1999):

1. Evaluate the operation and performance of the treatment facility to identify and correct treatment deficiencies contributing to effluent toxicity. Examples include ongoing operations problems, or problems that appear to correspond to toxicity episodes, new or enhanced chemical additions, and incomplete treatment as evidenced by failure to meet certain treatment criteria (e.g., BOD). In situations where these operational problems are readily apparent, correction may result in elimination of the observed toxicity.

2. Identify the physical, chemical or biological stressor(s) causing effluent toxicity. In most cases this will mean conducting a Toxicity Identification Evaluation (TIE).

3. Trace effluent toxicants and/or toxicity to the sources. Tracing effluent toxicity often involves progressively collecting effluent samples upstream in the treatment process.

4. Evaluate, select, and implement toxicity reduction methods or technologies to control effluent toxicity.

The degree of effort needed for each of these objectives will vary between TREs. In a complex treatment system, the first objective may prove to be the most critical and time consuming. In other systems, however, it is often that final objective that is the most difficult to accomplish, depending upon existing infrastructure and/or regulatory restrictions. Identification and implementation of an effective solution to resolve the toxicity issues must consider multiple factors including, but not limited to:

1. Source of toxicity in the process/waste treatment stream

2. Effectiveness of potential solutions

3. Logistical difficulty of implementing potential solutions, and integration of solutions with existing infrastructure

4. Negative and positive environmental impacts of mitigation alternatives

5. Monetary costs of alternatives

Fixing a WET problem cannot be based solely on only one of these factors, but must consider all factors in order to arrive at the most reasonable mitigation alternative. For example, elimination of toxicity originating from a specific chemical may be achieved though addition of certain treatment chemicals in a new or existing holding basin. On the other hand, toxicity reduction might also be achieved more simply by increasing the holding time in an existing basin or pond. The latter treatment may take longer to achieve the same toxicant reduction, but if it can be achieved using existing infrastructure at lower costs and reduced environmental impact, it may be the preferable alternative.

For Marathon's Steamboat Butte field, the TRE approach can be described in the following action items:

1. Site Characterization, Process Evaluation, and Planning
   a. Information and data acquisition
   b. Preparation of the TRE Action Plan
   c. Facility Performance Evaluation
      i. Examination and analysis of existing data
      ii. Collection of additional, targeted data with respect to potential toxicity sources
   d. Toxicity Identification Evaluation
      i. WET testing
      ii. Persistence testing and Phase I TIE (Toxicity Characterization)
   e. Phase II and III TIE (Toxicity Identification and Confirmation), if needed
2. Control Evaluations, Conceptual Design, and Benchtop Testing
   a. Toxicity Source Evaluation
      i. Determine the origin of the toxicant
      ii. May include ambient sources of toxicity and treatment stream
   b. Toxicity Control Evaluation
      i. Identify best treatment strategy
   c. Benchtop Studies
3. Field Pilot Testing
4. Full Scale Implementation

2.0 METHODS

2.1 Site Characterization, Process Evaluation, and Planning

Information to be used in the TRE will be obtained both from historical facility records and new data collected specifically for the TRE. Data acquisition will include, but not be limited to:

- Physical tour of the production field, wastewater handling and process stream and downstream conditions including the Mission Ponds and associated wetlands prior to the confluence with the Wind River
- Historical monitoring data from the wastewater and other applicable sources
- Historical whole effluent toxicity (WET) data
- New chemical and toxicological data, including TIE data from additional locations
- Hydrologic assessment and preparation of water balance
- Additional or alternative WET compliance strategies will be explored

All data will be evaluated using summary statistics, and the results used to prepare an annotated Action Plan. The Action Plan may include specific action items that are not apparent, *a priori*, but may be critical in resolving the toxicity issues, for example, conducting additional toxicity studies using water from various downstream locations.

2.1.1 Facility Performance

Performance of the Steamboat Butte Field water treatment system will be evaluated using the available DMR data, such as flow rate, biochemical oxygen demand (BOD), pH, total suspended solids (TSS), ammonia nitrogen, sulfide, etc.

Additional facility performance information may be collected as part of this TRE. For any given treatment facility there is a wide array of possible information and quantitative data that can be collected, not all of which will be related to probable causes of toxicity.

2.1.2 Toxicity Identification Evaluation

A TIE is a key component of this TRE. Identification of the cause of effluent toxicity is often the most important step in determining both the origin, and control, of the toxicant(s). Two rounds of Phase I testing have been conducted using effluent from Steamboat Butte Field. Results of that testing have been reported under separate cover. In brief, the completed Phase I (Toxicity Characterization) testing involved treating the effluent using 15 manipulations (USEPA 1991):

1) Baseline Toxicity (at initial pH)
2) Filtration (at initial pH)
3) C18-SPE (at initial pH)

4) Aeration (at initial pH)
5) pH 3 Baseline (acid adjustment)
6) pH 3 Filtration
7) pH 3 C18-SPE (solid-phase extraction)
8) pH 3 Aeration
9) pH 11 Baseline (base adjustment)
10) pH 11 Filtration
11) pH 9 C18-SPE
12) pH 11 Aeration
13) EDTA Chelation
14) Oxidant Reduction (Sodium Thiosulfate Addition)
15) pH Control at ambient pH with CO_2

Each of the characterization tests is intended to address one or more physical/chemical properties of the causative toxicant(s) (Table 2-1). For the Steamboat Butte Field effluent, an additional treatment of activated charcoal (AC) was added since it is highly effective in removing sulfide, a suspected toxicant in the Steamboat Butte Field effluent.

Table 2-1. Character of Toxicants Removed in Phase I Effluent Manipulations

Phase I TIE Test	Toxicants Addressed	Examples
Baseline Toxicity	None (a comparison for other tests)	---
pH Adjustment	Toxicants that degrade under acidic or basic conditions	Acidic = cyanide and sulfide Basic = malathion
Aeration	Toxicants that are oxidizable, volatile, or sublatable	Surfactants, organic compounds, sulfide
Filtration	Filterable toxicants	Cationic metals under basic conditions
SPE (solid-phase extraction w C_{18})	Non-polar organic toxicants	Pesticides, VOC
EDTA Chelation	Some cationic metals	Copper, zinc, nickel
Oxidant Reduction	Oxidants, some cationic metals	Chlorine, peroxide; copper, cadmium
pH Control	pH-sensitive toxicants	Ammonia, many metals
Activated Charcoal	Toxicants sorbing to organic surfaces	Cationic metals (e.g., Cu), sulfide

Although the completed Phase I TIE testing provided significant data to identify sulfide as the likely cause of all, or most, of the observed toxicity in Steamboat Butte Effluent, additional TIE testing may be needed. If further testing is initiated, the methods will follow those already applied, per USEPA guidance (USEPA 1991a; 1993a,b).

2.2 Toxicity Control Evaluations

2.2.1 Geological and Operational Considerations

The Steamboat Butte field is a northwest trending asymmetrical fault-controlled dome with the beds on the west side of the dome dipping at 20 to 50 degrees and the strata on the east side exhibiting shallower dips of 10 to 15 degrees. The primary oil production targets in the field include the Jurassic Nugget sandstone, Permian Phosphoria Formation and the Pennsylvanian Tensleep Sandstone. Numerous other oil-producing formations have been identified within the lease, but are of secondary importance. Consequently most wells in the field are perforated through several hydrocarbon-bearing zones and a co-mingled emulsion is recovered. Re-injection to flood the oil-bearing strata has been performed by previous operators and Marathon has continued with a patterned water flood strategy for pressure support and secondary recovery purposes.

As a potential source control measure, additional characterization and engineering evaluations may be performed during the TRE to assess the potential to isolate those formations yielding high sulfide levels and route produced water from those strata to the injection wells, thereby reducing the sulfide load to the NPDES discharge. Increased injection or water flood strategies might also reduce the volume of flow to the outfall such that the anticipated WET compliance limit might be avoided. In addition to other manipulations, consideration will also be given to the feasibility of discontinuing production from strata that are marginally economic which may yield a disproportionate H_2S or sulfide load to the produced water.

2.2.2 Process Considerations

Toxicant source reduction opportunities may also be identified throughout the oil-water separation process that could result in reduced sulfide levels at the NPDES outfall and waters that do not exhibit toxicity within the Mission Ponds system. Residence time, pH adjustment, carbon adsorption, and aeration are possible treatment options or process modifications that could result in reduced sulfide loading at the Mission Ponds discharge. Process flow diagrams will be prepared to identify and illustrate possible opportunities for integration of sulfide reduction processes or modifications to reduce toxicity at the outfall.

2.2.3 Chemical Use

Chemicals used as emulsion breakers, clarifiers, and corrosion inhibitors will be cataloged and evaluated for the potential to result in toxicity at the NDPES outfall or through the Mission Ponds treatment system. Process flow diagrams will be used to identify chemical addition points and possible reactions that may result in increased toxicity or sulfide retention in the produced water stream.

2.2.4 Conceptual Design and Benchtop Testing

Marathon and ENSR will work together to formulate conceptual designs and methods for toxicity reduction using benchtop or lab-scale models. An evaluation of the applicability and feasibility of these alternatives will be performed during the conceptual design stage. Following the benchtop study, further evaluation of the success of the treatment method with respect to ease of implementation, constructability, and economics will be used to identify which treatment or control methods will be evaluated during field-scale pilot testing.

2.3 Field Pilot Testing

Based on the results of the benchtop studies and knowledge of source control and/or treatment options acquired during the TRE process, Marathon intends to proceed into a field pilot testing program. Proportionally scaled pilot tests of the favored alternative(s) may be performed at the Steamboat Butte discharge or other produced water discharge sites that display similar chemical and physical characteristics. This process will involve a conceptual design, engineering, construction, and implementation phase. A monitoring program will be implemented to document the efficacy of the field scale testing for the selected alternative(s).

2.4 Full-Scale Implementation

Based on the results of the pilot testing program, full scale implementation of the selected toxicity control or source reduction method will proceed with a conceptual design and engineering effort in advance of Marathon's submittal of the renewal application for WY-0033740. USEPA approval of the renewal application will provide Marathon with the approval to implement the preferred full scale toxicity reduction method for the Steamboat Butte Outfall 001.

3.0 POSSIBLE COMPLIANCE STRATEGIES

In addition to pursuing compliance with the anticipated WET limits through evaluation of source control measures or treatment alternatives, Marathon will also explore regulatory or operational conditions that may help to achieve compliance. Several possible options are discussed in the following paragraphs which may provide additional compliance solutions.

When the current NDPES permit was issued, USEPA authorized the discharge to "Mission Pond", not an ephemeral tributary to the Wind River. With consideration to recent Supreme Court rulings, a detailed hydrologic evaluation will be performed during the TRE to assess whether the Mission Ponds system and the associated ephemeral drainage, which is tributary to the Wind River, should be considered waters of the U.S. An identification, or confirmation, of the appropriate discharge point with respect to the nearest waters of the U.S. will also be presented in the hydrologic study.

The applicability of WET monitoring requirements will be further explored if the flow through the NPDES could be reduced to less than 1,000,000 gallons per day. Should approximately 30% of the current discharge volume be reduced through diversion to underground injection or disposal wells, enhanced wetland management and evapo-transpiration, or reduced inflow from other sources, discharge to Mission Ponds might fall below this threshold. At such levels, Marathon believes that the Mission Ponds / wetlands system would still support localized beneficial use, but could potentially cease to discharge for any significant period of time. Therefore, with reduced flow or increased wetland uptake, no significant nexus to navigable waters would exist.

The TIE has identified sulfide as the primary toxicant at the NPDES outfall. There are currently no enforceable WET or sulfide limits imposed on this permit. As part of the TRE, Marathon will explore the feasibility of complying with an enforceable sulfide and/or WET limit at a downstream compliance point and designation of a mixing zone within Upper Mission Pond. Sulfide reduction may also be achieved by modifying or manipulating the processes that naturally occur between the outfall and Upper Mission Pond.

4.0 TOXICITY REDUCTION AND CONTROL

4.1 Review of Effective Treatments

Treatments that have been proven to be effective in reducing sulfide-related toxicity will be evaluated. Some treatments that are known to effectively reduce sulfide concentrations include:

- Chemical addition, such as
  - hydrogen peroxide and
  - commercial products that act independently and/or catalyze peroxides
- Acidification, which converts the majority of sulfides to hydrogen sulfide, which is a highly volatile form
- Aeration, which promotes volatilization; can be combined with acidification for maximum sulfide loss
- Increased effluent residence time and high surface area:volume ratios to promote volatilization and bacterial biodegradation

Although the completed TIE studies have implicated sulfide as a significant toxicant in Steamboat Butte Field effluent, the possibility of other toxicants still exists. If, during the TRE process, other toxicants are indicated, then effective treatments for those toxicants will be reviewed as well.

4.2 Analysis of Potential Alternatives

Any mitigation or treatment process that is implemented to reduce toxicity will have an associated monetary cost. Marathon does not believe that cost alone should dictate which alternative is selected for implementation. However, cost must be considered and weighed against other critical factors, such as environmental impacts and delays in implementation. Costs of alternatives will be discussed in the TRE.

A schedule will be developed for the implementation of the preferred strategy. The rapidity with which any control strategy can be implemented will obviously depend on the selected alternative. In most cases, final implementation will depend upon successful completion of several initial tasks or steps.

To quantitatively assess each alternative strategy for reducing toxicity to an acceptable level, the proposed alternatives will be ranked on several factors, including, but not limited to toxicity reduction efficacy, availability of equipment, personnel, etc., logistical issues associated with implementation, impacts on current production and/or operations, environmental impacts, regulatory hurdles and cost.

4.3 Design Considerations

The selection and implementation of a toxicity reduction system, if needed following the key TRE tasks outlined in this plan, will be related to the potential design of the system and potential spatial and functional limitations that might be imposed by the existing system and/or facility footprint. Marathon and its contractors will review all viable options and include that information as part of the treatment/mitigation process.

5.0 REPORTING

It will be necessary to frequently correspond with USEPA for guidance and recommendations as Marathon advances through our planned TRE activities. The TRE Action Plan will be prepared as we conclude the Site Characterization, Process Evaluation, and Planning phase. It is anticipated that the TRE Action Plan will be submitted during the second Quarter of 2010. Commencing in January 2009, semi-annual status reports will be prepared to summarize the activities that are occurring and those that are planned within the upcoming six-month period. Marathon will prepare a formal Annual Progress Report during the first Quarter of each calendar year summarizing the results, interpretations, and conclusions of the TRE activities completed. An updated schedule and detailed description of anticipated or planned activities will be included in the Annual Progress Report. Upon submittal of the Annual Progress Report, Marathon will prepare and deliver a presentation to USEPA and the Wind River Environmental Quality Council (as appropriate) which will summarize our progress and provide an opportunity for dialog to help guide our path forward.

Due to the complexity of the hydrologic system and the evaluation of the numerous compliance, process, and treatment options that will be explored during this TRE, Marathon proposes to submit the final Toxicity Reduction Evaluation report during the second Quarter 2012. This proposed schedule will allow for incorporation of process changes, treatment options, or identification of alternate compliance points into the renewal application for NPDES WY-0033740.

6.0 PROJECT ORGANIZATION AND TEAM

In cooperation with USEPA, the proposed Project Manager and team leader will be Michael A. Williams of Marathon's Rocky Mountain Oil Operation\s office in Cody, Wyoming. The key team members and their general responsibilities are summarized below:

1. Marathon Health, Environment, and Safety personnel will provide technical, regulatory, and legal guidance for all aspects of the project.

2. Marathon Operations personnel will provide engineering, chemical, and geological expertise to address the process modifications, equipment design, and geoscience challenges that this project will entail.

3. ENSR Environmental Toxicology Laboratory in Fort Collins Colorado will obtain water quality characterizations, perform benchtop studies, and acquire monitoring results during the site characterization and conceptual design phases. Dr. David Pillard will be the Senior Toxicologist for this project, and will assist in designing and implementing toxicity evaluations, if needed. ENSR, in concert with Energy Laboratories, will also perform all necessary WET testing, effluent analyses, in-stream characterization to identify and quantify the toxicant load and assess the results of the field pilot studies.

4. HydroSolutions, Inc., based in Billings, Montana, will assist in performing any hydrologic characterization, quantify beneficial use, and construct a water balance for the Mission Ponds system. HydroSolutions may also be integral to the conceptual / engineering design, pilot testing, and monitoring efforts.

7.0 PROJECT SCHEDULE

As illustrated in Table 7-1 , the anticipated project schedule encompasses the duration of the active permit for WY-0033740. The project is defined by five broad tasks or phases, the advancement of each will be dependant on the information gained during the completion of previous tasks. The site characterization, process evaluation, and planning phase will commence upon USEPA's approval of this Plan and we anticipate will be completed during the second Quarter of 2010. Control evaluations, conceptual design activities, and benchtop testing will be performed during 2010 and should be completed during the first Quarter of 2011. We anticipate that the field pilot test design, construction, implementation, and monitoring activities will be completed during 2011. The findings from these efforts will equip Marathon with the necessary information and design basis to proceed with the full-scale engineering for additional processes, equipment, or controls that shall be incorporated into the renewal NPDES application and can be implemented upon USEPA approval.

Table 7-1. Anticipated Project Schedule - Toxicity Reduction Evaluation

Marathon Oil Company - Steamboat Butte Field, NPDES Outfall WY-0033740-001

Phase Activity	2008		2009				2010				2011				2012			
	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Task I - Site Characterization, Process Evaluation, and Planning																		
Detailed Facility Description and Process Flow Diagram																		
Produced Water Chemistry and Process Chemical Inputs																		
Additional TIE Characterization Activities																		
Identification and Quantification of Beneficial Use																		
Hydrologic Characterization of Mission Ponds System																		
Effluent and In-stream Characterization																		
Water Balance for Mission Ponds System																		
Facility Performance Evaluation																		
Toxicant (Sulfide) Mass Balance																		
Task II - Control Evaluations, Conceptual Design, and Benchtop Tests																		
Alternative Water Discharge Methods																		
Toxicity Source and Control Evaluations																		
Identify and Rank Treatment Alternatives																		
Perform Benchtop Analyses for Preferred Alternative(s)																		
Prepare Conceptual Design for Field Pilot Test																		
Task III - Field Pilot Test																		
Engineering Design																		
Construction and Implementation																		
Performance Monitoring																		
Task IV - Full-Scale Implementation																		
Engineering Design																		
Construction and Implementation																		
Task V - Correspondence and Reporting																		
TRE Action Plan																		
Semi-Annual Status Report																		
Annual Progress Report																		
Final TRE Report																		
Presentations to USEPA / WREQC																		

Notes: Current permit expires September 12, 2012, upon renewal Marathon will finalize the engineering design and commence with full-scale construction activities.

8.0 REFERENCES

USEPA. 1991a. Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures (Second Edition). EPA/600/6-91/003.

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USEPA, 1999. Toxicity Reduction Evaluation Guidance for Municipal Wastewater Treatment Plants. EPA/833B-99/002. Office of Wastewater Management, Washington, DC.